

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:
  - a foundation having a first conductive region;
  - an interconnection layer provided separate from  
5 the foundation;
  - a first region occupying a range from the foundation to the interconnection layer, and filled with gas or provided with a first interlayer dielectric film;
  - 10 a conductive first connection plug provided in the first region, and electrically connecting the first conductive region and the interconnection layer; and a dielectric first support plug provided in the first region, the gas being filled or the first interlayer dielectric film being provided between the first connection plug and the first support plug, the first support plug extending from the interconnection layer to the foundation and having a second Young's modulus.
  - 15
- 20 2. The device according to claim 1, wherein the second Young's modulus is 10 or more.
3. The device according to claim 1, wherein the first region is provided with the first interlayer dielectric film having a first Young's modulus, and the second Young's modulus is higher than the first Young's modulus.  
25
4. The device according to claim 3, wherein the

second Young's modulus is two times or more the first Young's modulus.

5       5. The device according to claim 3, wherein the first interlayer dielectric film consists essentially of a material having a dielectric constant of 2.6 or less.

6. The device according to claim 1, wherein the foundation has a second conductive region,

10      the device further includes a conductive second connection plug, which is provided in the first region and electrically connects the second conductive region and the interconnection layer,

15      the interconnection layer extends on the second connection plug, and is electrically connected with the second conductive region via the second connection plug, and

the first support plug is positioned between the first and second connection plugs along the interconnection layer.

20      7. The device according to claim 6, further comprising:

a dielectric second support plug provided in the first region, and extending from the interconnection layer to the foundation, and

25      wherein the interconnection layer extends on the second support plug,

the second support plug being positioned between

the first support plug and the second connection plug along the interconnection layer.

8. The device according to claim 6, further comprising:

5 dielectric third to n-th support plugs provided in the first region, and extending from the interconnection layer to the foundation, and wherein the interconnection layer extends on the third to n-th support plugs,

10 the total area of the first to n-th support plugs facing a surface of the interconnection layer is 1 to 80% of the area of the interconnection layer facing the foundation.

15 9. The device according to claim 1, wherein the first support plug consists essentially of a material selected from a group consisting of SiO, SiN, SiC and SiOC.

20 10. The device according to claim 1, further comprising a support layer provided so that its upper end is positioned at the same height as the upper end of the interconnection layer, and consisting essentially of the same material as the first support plug.

11. The device according to claim 10, wherein the thickness of the support layer is 5 to 300 nm.

25 12. The device according to claim 1, further comprising a second interlayer dielectric film provided on the interconnection layer.

13. A semiconductor device comprising:

a foundation having a first conductive region;

a first interlayer dielectric film provided on the foundation, having a first through hole ranging from its upper surface to the foundation and a second through hole ranging from its upper surface to the first conductive region, and having a first Young's modulus;

10 a dielectric first support plug provided in the first through hole, and having a second Young's modulus higher than the first Young's modulus;

a conductive first connection plug provided in the second through hole; and

15 an interconnection layer provided on the first interlayer dielectric film, extending from the first connection plug to the first support plug, and electrically connected with the first conductive region via the first connection plug.

14. The device according to claim 13, wherein the second Young's modulus is 10 or more.

15. The device according to claim 13, wherein the second Young's modulus is two times or more the first Young's modulus.

25 16. The device according to claim 13, wherein the first interlayer dielectric film consists essentially of a material having a dielectric constant of 2.6 or less.

17. The device according to claim 13, wherein the foundation has a second conductive region,

the first interlayer dielectric film has a third through hole ranging from its upper surface to the  
5 second conductive region,

a conductive second connection plug is provided in the third through hole,

the interconnection layer extends on the second support plug, and is electrically connected with the  
10 second conductive region via the second connection plug, and

the first support plug is positioned between the first and second connection plugs along the interconnection layer.

15 18. The device according to claim 13, wherein the first interlayer dielectric film has a fourth through hole ranging from its upper surface to the foundation,

a dielectric second support plug having a Young's modulus higher than the first interlayer dielectric  
20 film is provided in the fourth through hole,

the interconnection layer extends on the second support plug, and

the second support plug is positioned between the first support plug and the second connection plug along  
25 the interconnection layer.

19. The device according to claim 18, wherein the first interlayer dielectric film has fifth to n+2-th

through holes ranging from its upper surface to the foundation,

5 dielectric third to n-th support plugs are provided in the fifth to n+2-th through holes having a Young's modulus higher than the first interlayer dielectric film,

the interconnection layer extends on the third to n-th support plugs, and

10 the total area of the first to n-th support plugs facing the surface of the interconnection layer is 1 to 80% of the area of the interconnection layer facing the foundation.

15 20. The device according to claim 13, wherein the first support plug consists essentially of a material selected from a group consisting of SiO, SiN, SiC and SiOC.

20 21. The device according to claim 13, further comprising a support layer provided so that its upper end is positioned at the same height as the upper end of the interconnection layer, and consisting essentially of the same material as the first support plug.

22. The device according to claim 21, wherein the thickness of the support layer is 5 to 300 nm.

25 23. The device according to claim 13, further comprising a second interlayer dielectric film provided on the interconnection layer.

24. A method of manufacturing a semiconductor device comprising:

forming a foundation having a first conductive region;

5 depositing a first interlayer dielectric film having a first Young's modulus on the foundation;

10 forming a first through hole in the interlayer dielectric film, the first through hole ranging from an upper surface of the interlayer dielectric film to the foundation;

15 forming a first insulating film having a second Young's modulus higher than the first Young's modulus on the interlayer dielectric film, the first insulating film buried in the first through hole;

20 forming a second through hole in the interlayer dielectric film, the second through hole ranging from the upper surface of the interlayer dielectric film to the first conductive region;

25 forming an interconnection trench on the surface of the interlayer dielectric film so that the bottom portion of the interconnection trench is connected with the second through hole and the interconnection trench extends on the first insulating film in the first through hole; and

25 filling the second through hole and the interconnection trench with a first conductive film.

25. The method according to claim 24, further

comprising:

removing the first insulating film formed on the interlayer dielectric film after forming the first insulating film.

5        26. The method according to claim 24, further comprising:

depositing a second insulating film on the first insulating film formed on the interlayer dielectric film and on the first conductive film buried in the 10 interconnection trench after the second through hole and the interconnection trench are filled with the first conductive film; and

removing the interlayer dielectric film.

27. The method according to claim 25, further 15 comprising:

depositing a second insulating film on the interlayer dielectric film and the first conductive film buried in the interconnection trench after the second through hole and the interconnection trench are 20 filled with the first conductive film; and

removing the interlayer dielectric film.

28. A method of manufacturing a semiconductor device, comprising:

forming a foundation having a first conductive 25 region;

forming a pillar support plug having a second Young's modulus on the foundation;

forming an interlayer dielectric film having a first Young's modulus on the foundation to cover the support plug, the second Young's modulus being higher than the first Young's modulus;

5 forming a connection plug reaching the first conductive region in the interlayer dielectric film; and

10 forming an interconnection layer in a surface of the interlayer dielectric film, the interconnection layer extends on the support plug and the connection plug.

29. The method according to claim 28, wherein forming the support plug includes:

15 depositing a material film for the support plug on the foundation;

forming a mask material having a pattern corresponding to a shape of the support plug on the material film; and

20 etching the material film using the mask material as a mask.

30. The method according to claim 28, wherein forming the support plug includes:

depositing the first insulating film on the foundation;

25 forming a through hole in the first insulating film, the through hole ranging from the upper surface to the foundation;

filling the through hole with the material film  
for the support plug; and  
removing the first insulating film.